

REMARKS

By the present amendment and response, independent claim 7 and dependent claim 10 have been amended to overcome the Examiner's objections. Claims 7-11 and 21-47 are pending in the present application and claims 21-47 have been allowed. Reconsideration and allowance of outstanding claims 7-11 in view of the following remarks are requested.

The Examiner has rejected claims 7 and 10-11 under 35 USC §103(a) as being unpatentable over U.S. patent number 6,146,959 to DeBoer et al ("DeBoer") in view of U.S. patent number 5,741,626 to Jain et al ("Jain"). For the reasons discussed below, Applicant respectfully submits that the present invention, as defined by amended independent claim 7, is patentably distinguishable over DeBoer and Jain, singly or in combination.

The present invention, as defined by amended independent claim 7, teaches a capacitor comprising a dielectric comprising ceramic tantalum nitride situated between first and second capacitor electrodes, "said dielectric comprising ceramic tantalum nitride having a nitrogen content of at least 30%." As disclosed in the present application, when the percentage of nitrogen content in the tantalum nitride reaches approximately 60%, the tantalum nitride becomes highly resistive, which indicates that it (i.e. tantalum nitride) is in a ceramic mode. As disclosed in the present application, the present invention can achieve ceramic tantalum nitride by fabricating tantalum nitride with a nitrogen content of at least 30%. In the ceramic mode, tantalum nitride exhibits a high dielectric constant,

which allows the present invention to utilize fabricated ceramic tantalum nitride as a dielectric to advantageously achieve a capacitor having a relatively high capacitance density. Furthermore, as disclosed in the present application, the present invention's capacitor can be advantageously fabricated in a single ionized metal plasma ("IMP") tool without having to remove the semiconductor wafer from the IMP tool.

In contrast to the present invention as defined by amended independent claim 7, DeBoer does not teach, disclose, or suggest a capacitor comprising a ceramic tantalum nitride dielectric, where the dielectric comprising ceramic tantalum nitride has a nitrogen content of at least 30%. DeBoer specifically discloses capacitor 10, which comprises Ta₂O₅, i.e. tantalum pentoxide, layer 18 situated between silicon nitride layer 16 and second nitride layer 20. See, for example, column 1, lines 56-67, column 2, lines 16-17 and Figure 1 of DeBoer. DeBoer further discloses that tantalum pentoxide is generally amorphous if formed below 600° C and will be crystalline if formed, or later processed, at or above 600° C. See, for example, column 2, lines 9-11. However, as discussed above, ceramic tantalum nitride is formed in the present invention by fabricating tantalum nitride with a nitrogen content of at least 30%. In contrast, DeBoer discloses fabricating tantalum pentoxide at a temperature below 600° C to form amorphous tantalum pentoxide, which is different than ceramic tantalum nitride. Thus, DeBoer does not teach, disclose, or suggest forming ceramic tantalum nitride.

Moreover, DeBoer is concerned with developing alternative methods of utilizing tantalum pentoxide in integrated circuit construction as a result of the high dielectric

constant of tantalum pentoxide, i.e. approximately 25. See, for example, DeBoer, column 1, lines 16-17, and column 2, lines 47-48. In contrast, as disclosed in the present application, the dielectric constant of ceramic tantalum nitride is approximately 10. Thus, since tantalum pentoxide has a higher dielectric constant than ceramic tantalum nitride, DeBoer would not be motivated to replace a dielectric having a higher dielectric constant, i.e. tantalum pentoxide, with a dielectric having a lower dielectric constant, i.e. ceramic tantalum nitride.

In contrast to the present invention as defined by amended independent claim 7, Jain does not teach, disclose, or suggest a capacitor comprising a ceramic tantalum nitride dielectric, where the dielectric comprising ceramic tantalum nitride has a nitrogen content of at least 30%. Jain specifically discloses forming semiconductor structure 10 by depositing first dielectric layer 16 over conductive region 14, which is formed over semiconductor substrate 12, and depositing dielectric tantalum nitride layer 18 over first dielectric layer 16. See, for example, column 2, lines 50-67, column 3, lines 7-16, and Figure 1 of Jain. In Jain, dielectric tantalum nitride layer 18 is utilized mainly as an anti-reflective coating layer, since dielectric tantalum nitride layer 18 comprises a dielectric phase of tantalum nitride, which has superior light absorption qualities. See, for example, Jain, column 2, lines 11-34. However, Jain fails to teach, disclose, or suggest a dielectric comprising ceramic tantalum nitride, where the dielectric comprising ceramic tantalum nitride has a nitrogen content of at least 30%. Furthermore, Jain fails to mention forming a ceramic form of tantalum nitride.


For the foregoing reasons, Applicant respectfully submits that the present invention, as defined by amended independent claim 7, is not suggested, disclosed, or taught by DeBoer and Jain. Thus, amended independent claim 7 is patentably distinguishable over DeBoer and Jain and, as such, claims 10 and 11 depending from amended independent claim 7 are, *a fortiori*, also patentably distinguishable over DeBoer and Jain for at least the reasons presented above and also for additional limitations contained in each dependent claim.

The Examiner has further rejected claims 8 and 9 under 35 USC §103(a) as being unpatentable over DeBoer in view of Jain and further in view of U.S. patent number 5,170,318 to Catala et al (“Catala”). As discussed above, amended independent claim 7 is patentably distinguishable over DeBoer and Jain and, as such, claims 8 and 9 depending from amended independent claim 7 are, *a fortiori*, also patentably distinguishable over DeBoer and Jain for at least the reasons presented above and also for additional limitations contained in each dependent claim. Moreover, the features of amended independent claim 7, for example a dielectric comprising ceramic tantalum nitride situated between a first and second capacitor electrode, are not suggested, disclosed, or taught anywhere in Catala. As such, amended independent claim 7 as well as claims 8 and 9 depending therefrom are also patentably distinguishable over DeBoer and Jain in combination with Catala.

Based on the foregoing reasons, the present invention, as defined by amended independent claim 7, and claims depending therefrom, is patentably distinguishable over the art cited by the Examiner. Thus, claims 7-11 are patentably distinguishable over the art cited by the Examiner. For all the foregoing reasons, an early allowance of outstanding claims 7-11, and an early Notice of Allowance for all pending claims 7-11 and 21-47 is respectfully requested.

Respectfully Submitted,
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